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Is There a New Pulp Game in Town?

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Are we on the verge of witnessing a technology disruptor in the field of pulping and pulp fibers? The talk of a disruptor in pulp is understandably a strong statement, but then again, most disruptors are not thought to be so at the time. Who knew Starbucks would change the way most of the world drinks coffee? Or that Netflix would change the way the United States watches TV? Or that e-commerce would change the way we all shop?

Using a definition from Software Advice, a technology disruptor is “any industry trend or new technology that is already changing or will fundamentally change how business success is achieved.” From that statement, there is a case to be made that potential disruption is being led by Sustainable Fiber Technologies (SFT).

Under the guidance of Mark Lewis, SFT has developed a new pulping process named The Phoenix Process™. This pulping process, specific for non-woody fibers, is highly confidential and shrouded in secrecy but amongst its benefits, the process is known to be non-pressurized and to use no sulfur.

Sustainable Fiber Technologies

Why consider this new pulping process from SFT a disruptor? From information publicly distributed by SFT, the resultant pulp from wheat straw and other non-woody fibers will be as strong or stronger than virgin bleached hardwood pulp, competitively priced, and have an unequaled environmental story to tell prospective customers and consumers.

For the most part today in North America, wheat straw and other cereal straws are either plowed under by the farmer where possible, or literally burned in the fields. Both methods of disposal have issues associated with them. The burning of the wheat straw in the western United Sates causes air quality concerns and releases significant amounts of CO2. Obviously producing pulp from the wheat straw would remove that straw from the burning process.

In past attempts, pulping wheat straw produced a pulp that had low fiber length, poor strength characteristics, extremely poor wire drainage, which yielded no product benefits. Up until now, in the United States, wheat straw, cereal grain straws, and other non-woody materials have not been considered as a viable hardwood fiber substitute in the papermaking process.

Wheat straw pulp and other non-woody pulps have been around for a long time. Pulping non-woody plants and generating this type of pulp is actually a common practice in some parts of the world today where wood is less plentiful than in North America. Looking to invest in non-woody pulp technology, just a couple of years ago Shandong-Tranlin was to invest $2 billion to build a facility in Chesterfield County, Virginia. This company, renamed Vastly later on, was to use corn stalks and wheat straw to manufacture pulp and produce paper as well as convert it into a finished product. This mill was also going to generate a secondary product that would be sold in the local area as a soil supplement and fertilizer. The project, however, never really got off the ground and has been canceled but the model for this facility was the process now being used by Shandong-Tranlin in China today.

The Phoenix Process has been well studied and developed through basic research and by running a pilot facility generating pulp for machine trials using a wide range of non-woody feedstock, and the pulp has been used in paper machine trials making a wide variety of paper products. The new pulping process, per SFT, has been tested with wheat straw, alfalfa, other cereal grain straws, and various grass species. The test results of the specific pulp are documented and have been presented at different paper conferences.

One of the first questions papermakers and product technologists ask is about the fiber length of the pulp. Figure 1 shows the weighted average fiber length of non-woody pulps from the Phoenix Process as compared to an industry accepted average fiber length for selected pulps and, as reported by SFT, fiber lengths from the Phoenix Process are acceptable.

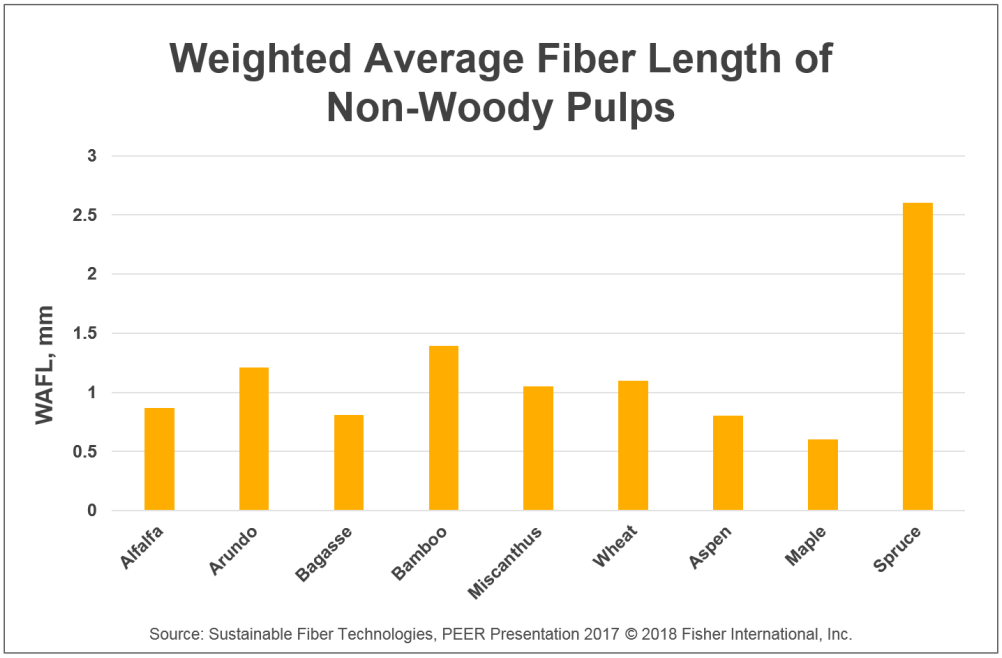

Figure 1

Following fiber lengths, papermaker and product technologists want to understand the potential strength development of the fibers. Figures 2 and 3 show the strength development for tensile and tear at different Canadian Standard Freeness values as tested by SFT. The strength figures show that there is significant room for the product development personnel to optimize product strength with bulk trade-offs.

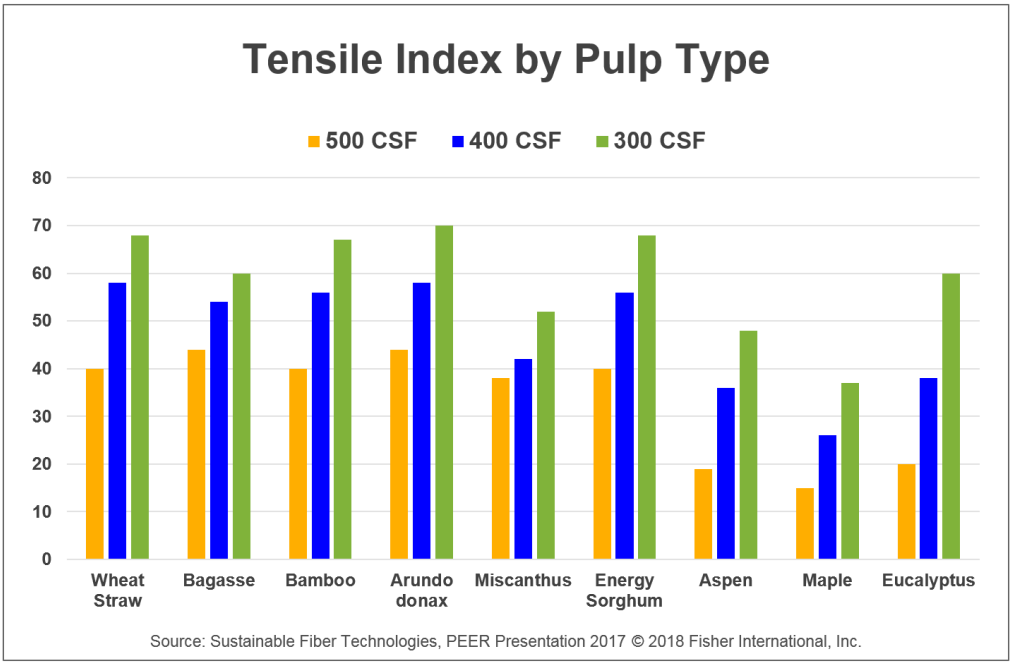

Figure 2

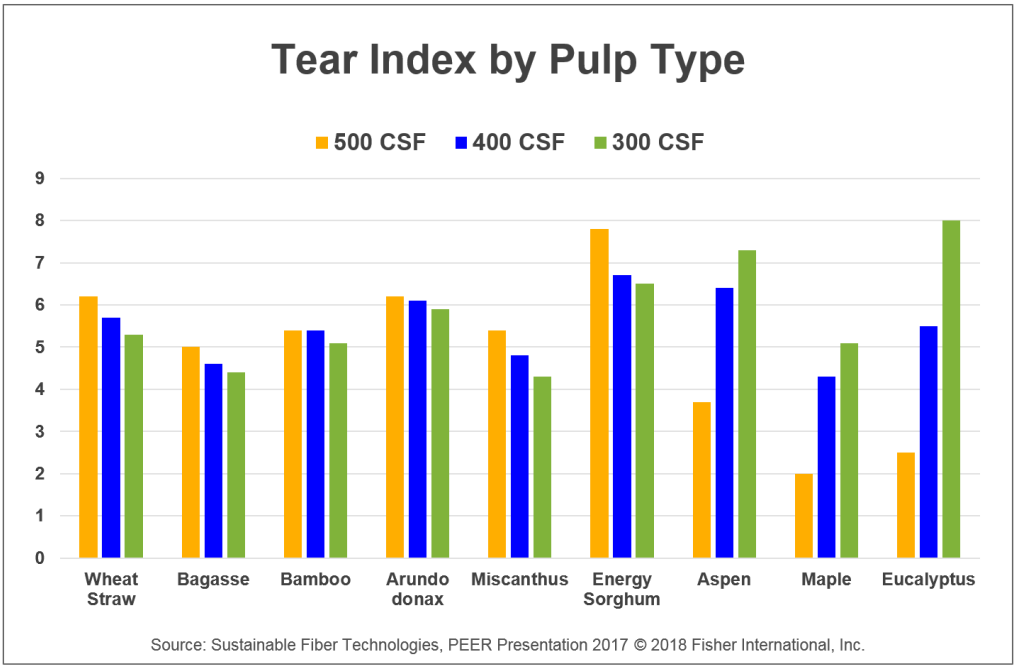

Figure 3

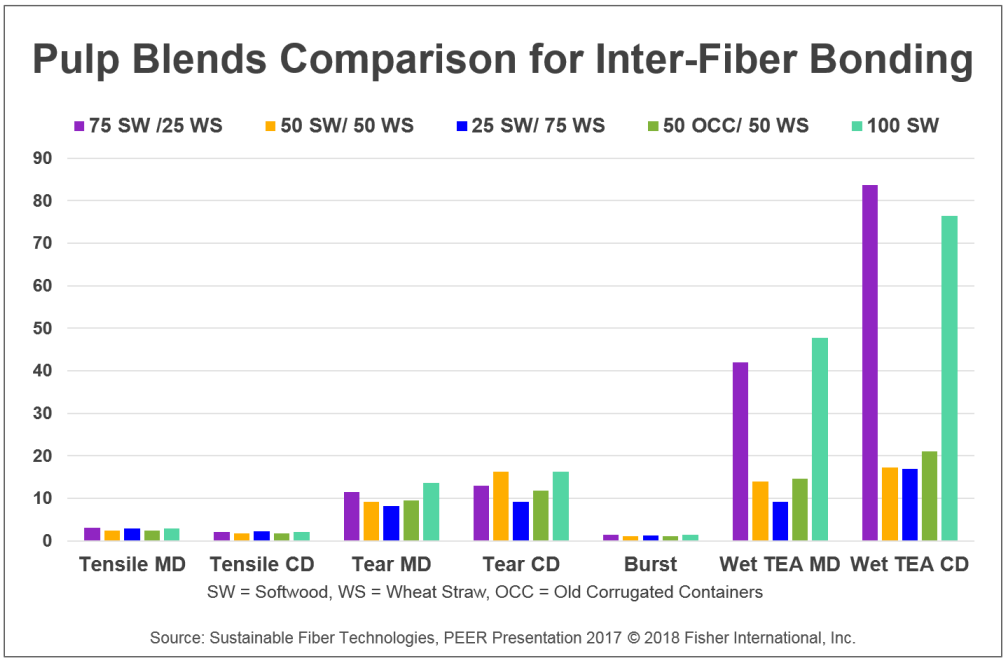

Figure 4

After testing the individual pulps and understanding the specific fiber characteristics, there is a need to understand the interaction of the fiber under study with other fibers in "real scenario" situations. This ensures that there are no surprises with respect to inter-fiber bonding. Figure 4 shows the paper test results of wheat straw pulp with a typical softwood and OCC fiber blends as would be found on most paper machines in a daily production mode. As expected, 100% softwood has the highest tear index, but the wheat straw blend has an acceptable tensile value.

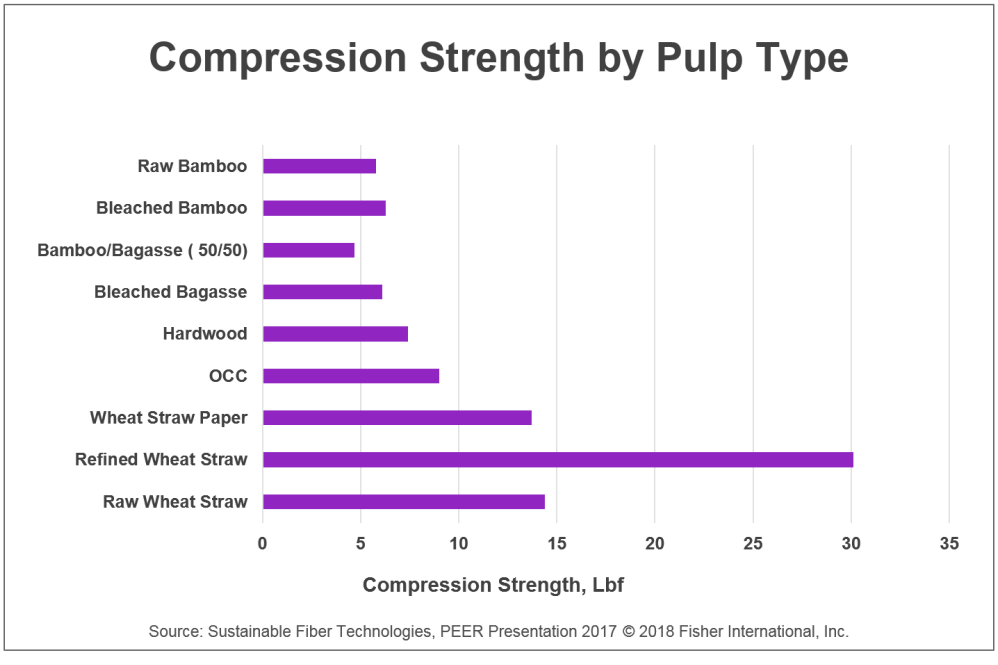

Figure 5

In the field of board packaging, product development personnel need to understand the compression strength and the bending strength.

Figures 5 and 6 show this for selected pulps. The SFT test results demonstrate that the wheat straw pulp produced via the Phoenix Process is superior to OCC and to hardwood pulps for these tests. This gives the product technologist room to develop superior performing cost-effective products for their customers.

It also provides the opportunity to experiment with non-traditional fibers.

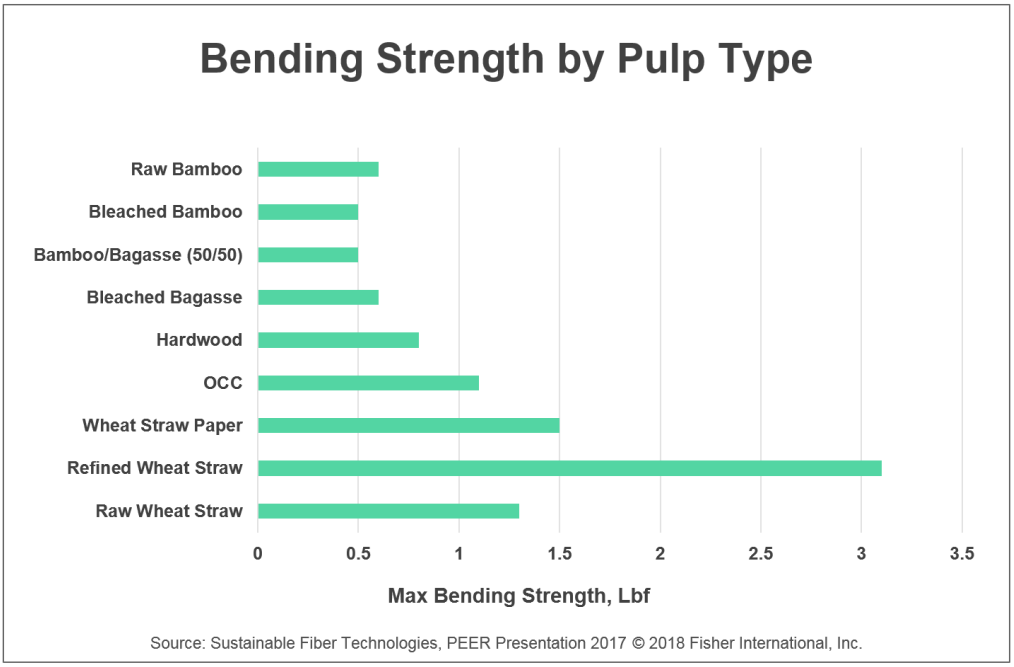

Figure 6

Some of the pilot plant testing results, as shared by SFT, show that the Phoenix Process will have a:

- Yield of 65%
- Co-product yield of 40% (the co-product is a concentrated mix of lignin and other carbohydrates)
- Chemical consumption of 25% compared to unbleached virgin hardwood
- Energy consumption of 15% compared to unbleached virgin hardwood

If the pilot plant test results scale up to commercial operations from the listed benefits of the pulping process, it is easy to understand the potential disruption capability. The low raw material costs, the low capital cost due to non-pressurized cooking, no recovery process, the lack of air quality concerns to the point where the state of Washington determined that this is a non-significant source of emissions, coupled with the relatively high yield, low chemical cost, and low energy costs, is projected to generate a market-ready pulp that could be environmentally preferred to typical wood based market pulp and attractively priced.

A paper company and a converter are concerned with more than just pulp costs. How does it run on the paper machine? What is the paper strength and performance level of the product? Again, using information shared by SFT, successful paper machine trials of this wheat straw pulp have been documented for producing:

- AFH bleached tissue and towel products at a 25% level of the furnish with no change in performance or appearance in the bleached finished product

- Linerboard replacing hardwood and OCC with improved performance test results
- 25 pt. coated board with no change in performance
- In the 1st and 2nd layers of board from a cylinder machine for folding boxboard
- Specialty papers with improved opacity and smoothness plus higher strength

Some general findings of the Phoenix Process pulp conclude:

- It has been tested and is qualified as FDA direct food contact compliant, and is on the BioPreferred products list
- It has replaced UBSWK, BEK, NBHK, and NBSK in successful machine trials
- When 25% wheat straw replaces 25% of softwood, there is a 10% tensile loss so there is some strength loss when the wheat straw replaces softwood
- It is stronger than bleached hardwood pulp
- It is stronger than OCC
- It can be bleached to the low 80s in brightness if needed

The Phoenix Process has been licensed by SFT to five different companies. One of the licensed companies, located in Florida, started up in 2017 using the Phoenix Process to cook sugarcane as the raw material feedstock.

Companies that have licensed the Phoenix Process will compete with traditional wood pulps. However, the basis of competition will not be based strictly on price; the main basis of competition will be that this fiber is a non-traditional alternative and is environmentally preferred.

According to SFT, the non-woody fiber produced via the Phoenix Process:

- Is just as strong or stronger than traditional hardwood fibers
- In product performance testing, the Phoenix Process pulp meets performance expectations
- Is tree-free
- Uses only 10-15% of the amount of water as traditional wood pulp mills (water is expected to become a valuable resource in the future as some locations are already water-short)
- Non-woody mills will have zero water discharge eliminating any water pollution issues
- Odor free pulping because of zero sulfur and the non-pressurized process
- No air quality pollution issues, as there is no recovery boiler and there will be no chance of any TRS releases or particulate emissions
- The raw material feedstock is agricultural waste that is sometimes burned in the fields producing pollution issues
- Turns a waste product with no value into a value-added product
- Uses only 10-15% of the energy as a traditional wood pulp mill
- Uses about 25% of the chemical usage as a traditional wood pulp mill

SFT is making many claims as to the performance and acceptability of the wheat straw pulp. It remains to be seen whether the commercial operations will produce a

pulp as acceptable and as cost-effective as the pilot plant pulps. It also remains to be seen whether the paper machine trials will yield successful commercial paper machine runs on a consistent basis. Finally, the paper will need to be converted into acceptable finished products that customers will purchase from a cost and product performance standpoint.

Columbia Pulp Company

The Columbia Pulp Company will be the first commercial operation to utilize the Phoenix Process using wheat straw as the raw material. The trial runs to date mentioned earlier were done in conjunction with Columbia Pulp using, for the most part, Columbia's expected feedstock of 95% wheat straw and 5% alfalfa.

Columbia Pulp is well along in their construction and start-up schedule. There will be no recovery boiler associated with this facility, and the co-product is concentrated cooking liquor that will be removed from the pulp after cooking. The plan for Columbia Pulp is to sell the co-product at 40% solids. It can be used for dust abatement, soil supplements, and fertilizer to farmers in the local area. If Columbia Pulp decides in the future to add more value to the co-product, more processing, purification, and refining will be required but it may very well be worth it in the generation of specialized chemicals.

The lignin in the co-product will be a non-condensed form since there is no sulfur and that would make the lignin suitable for selling in a dry powder form that would be water soluble. The co-product will also be rich in C5 and C6 sugars. Many other high value products can be produced from the spent liquor. Shipping the wet-lap pulp should not be a deterrent for Columbia Pulp's finished product as there are many paper mills within a 300-mile radius.

As Columbia Pulp is in a region where high amounts of wheat are grown, they expect to be able to obtain all their raw material feedstock within a 75-mile radius of the facility. According to the USDA, there is approximately 4.8 million tons of wheat straw available in the nine counties surrounding the Columbia Pulp mill.

The pulp will be unbleached, but it will have a high L value, meaning it will be more yellowish and have the appearance of a manila folder as opposed to a virgin unbleached hardwood that has the appearance of a typical brown grocery bag. As Columbia Pulp will be using wheat straw as their primary raw material, the wheat is only harvested once per year - a potential issue is the long-term storage of the bales of straw. Large warehouses have been built as part of the manufacturing process to store the straw to prevent its deterioration. The expectation is that the straw, which is basically dry when baled in the field, will be kept dry with no spoilage of the bales between the harvest cycles.

Columbia Pulp's product is going to cater to the regional Pacific Northwest paper mills which, to Columbia Pulp, justifies the finished product being wet-lap pulp as opposed to fully dried bales of pulp. Figure 7 shows a 300-mile radius around Columbia Pulp's location in Starbuck, WA. Columbia Pulp is expecting to ship their pulp within a 500-mile radius. However, for the purposes of this review, with a wet-lap pulp product, it seemed reasonable to consider a shipping limit of 300 miles.

With this being used as a shipping limit, this radius covers parts of Montana, most of Idaho, all of Washington, and the more populated areas of Oregon. It just so happens that this covers all the pulp and paper producing mills in the Pacific Northwest, but it does miss out on paper mills in British Columbia, Nevada, and California.

A 300 Mile Radius Shipping Limit Covers Most Pulp and Paper Producing Mills in the Pacific Northwest

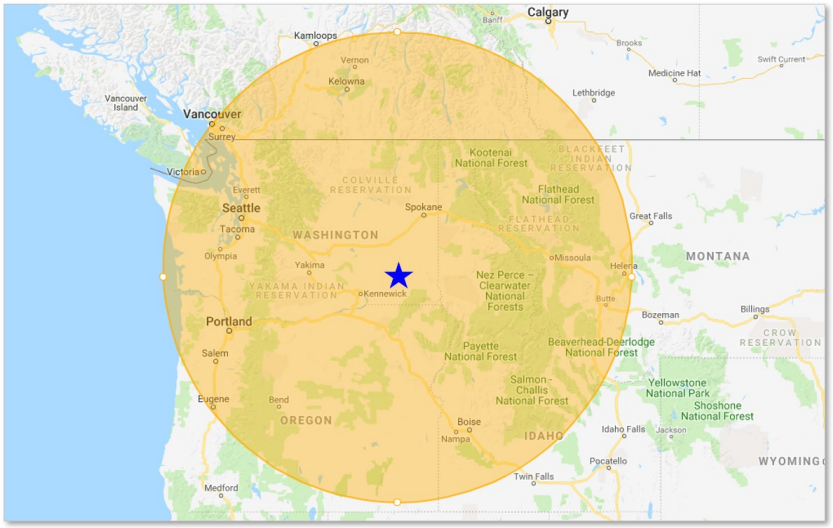

Figure 7

Figure 8 shows products and types of pulp consumed by paper mills within the 300-mile radius as listed in the Fisher*Solve* database, and covers a range of products from SBS, kraft papers, newsprint, directory paper, copying paper, tissue and towel, containerboard, and boxboard. The various companies producing these paper grades consume approximately 7.3 MM AD tons of pulp. These figures and types of pulp consumed tend to confirm that the Pacific Northwest is somewhat void of an acceptable hardwood that other parts of the country enjoy.

Columbia Pulp's initial focus will be on paper companies producing:

- Tissue, towel, and napkins
- Consumer packaging companies for blister packs or containers
- Food service companies for plates, cups, and other carry-out items
- P&W grades for products like copying papers
- Molded pulp product companies

The rationale is that there is high demand for a non-traditional fiber that is environmentally friendly and highly sustainable. A good overview of Columbia Pulp's layout, process, and expectations was covered in a presentation to the Washington Economic Development Financial Authority in November of 2016. The information presented was a basic outline of the mill with a projected business plan.

Since then, however, there have been new learnings due to the pilot plant trials and the paper machines trials. The additional research and trials since 2016 have generated new information and data and these new finds have refined the process and the projections.

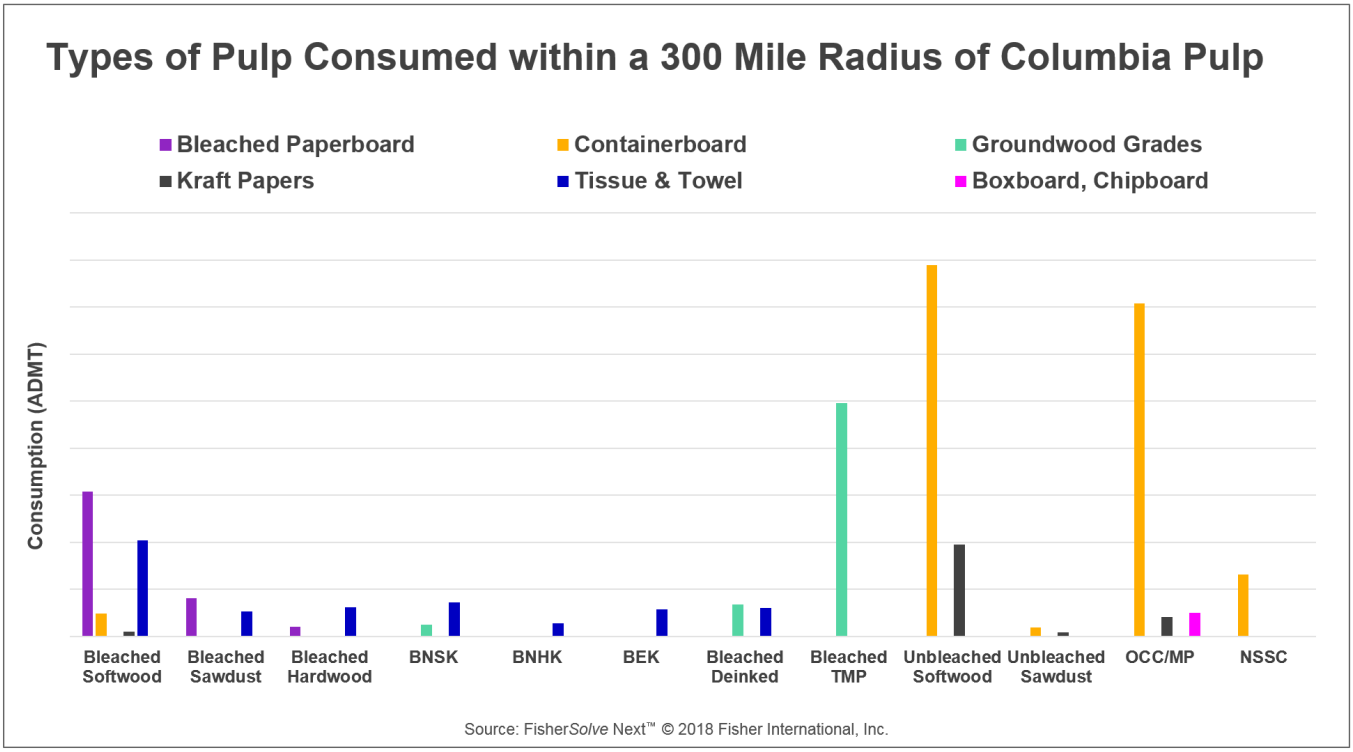

Figure 8

Potential Disruptor

As proposed, mills such as Columbia Pulp pose a potential disruption to the marketplace. Compared to kraft virgin unbleached hardwood pulp:

- Capital costs to build a facility could be substantially lower per annual ton
- Chemical consumption is projected to be only 25% as much
- Energy consumption for the wet-lap pulp is projected to be 15% as much
- Columbia Pulp mill is targeted to be a zero effluent discharge mill
- The pulp can be substituted for hardwood
- The environmental and sustainable attributes previously mentioned are a powerful selling tool as it is utilizing a waste product to generate a valuable pulp
- Companies will be able to market their products as containing wheat straw pulp to consumers
- The feedstock is a sustainable on an annual basis
- Air quality impact is minimal, and the facility is not considered a HAP discharger
- The second revenue stream of the co-product can be very valuable
- There is inherent simplicity to the operations as there is no pressurized vessels and no recovery process

While the potential benefits of Columbia Pulp have been demonstrated via research and pilot plant trials, the technology remains to be proven on a commercial scale. Storage of the once-per-year harvested wheat straw and the prevention of raw material deterioration is critical. Cost control of the process and the finished product is paramount. The finished product, namely the wet-lap pulp also must be proven to be consistent in quality and strength and perform to expectations on commercial paper machine trials over time. The converted product containing the wheat straw pulp must also be proven to meet customer performance expectations in a cost-effective manner.

Even though there is much to be demonstrated about Columbia Pulp, it will be important for paper companies and consumer packaging companies to keep this new pulping process and Columbia Pulp on their radar.

Food for thought:

- Is this technology disruptive or complementary?
- How does this fit with our industry's current supply chain? What will be needed?
- What implications does this have to the global marketplace?

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About Fisher International, Inc.

Fisher International, by virtue of its deep expertise in the pulp and paper industry, provides insights, intelligence, benchmarking, and modeling across myriad scenarios. By arming companies with the knowledge that will help them gain a better understanding of their strengths and help identify weaknesses, Fisher is helping businesses stave off challenges and better position themselves for long-term growth.

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